

Telemedicine and Toxicology: Back to the Future?

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I was recently consulted via our poison control center (PCC) regarding a toddler who arrived at an Arizona pediatric intensive care unit. The child had first presented to a rural facility where he was evaluated and treated for presumed sepsis. The intensivist I spoke with on the phone was new to our state and suspected that the patient had an alternate diagnosis. After consenting the child's mother, he securely transferred a short video of the child's examination. We reviewed the video together on the phone and, after recognizing the opsoclonus characteristic of *Centruroides* envenomation, we treated the child with scorpion antivenom. The patient was safely discharged to home a few hours later, asymptomatic.

Reflecting on the experience of this video diagnosis, it occurred to me that medical toxicologists were among the earliest pioneers in the field of telemedicine. However, the nature of telemedicine is rapidly growing and changing. Are toxicologists and poison centers doing enough to keep up with the tide of information technology? What will the remote toxicology practice of the future look like?

Past

Looking back to 1953, the first poison information center in Chicago was little more than a desk, a clerk, a telephone, and paper files of information. The concept of providing expert consultation remotely to health care professionals (and eventually to the public) was so successful that by 1978, there were 661 poison centers in the USA and the need for consolidation and regionalization was apparent [1].

And what of managing the volume of information required for sound medical advice? In the early 1950s, files and stacks of 5×8 in. index cards accumulated at

each center, each referencing a single consumer product. This was followed by the publication of *Clinical Toxicology of Commercial Products* in 1957, a robust reference text for over 25,000 substances [2]. The Poisindex™ that we are all familiar with was once a three-ringed binder stuffed with microfiche. Then, in 1972, a technological breakthrough occurred. The critical information on thousands of household products was transferred for the first time to computer tapes and satellite terminals established at regional poison centers. The end user could type in the name of a product, and after waiting for the signal to travel by telephone line to a computer in Baltimore, "... in greenish lighted print, information regarding the product and management of poisoning" would appear on the screen [1]. To put this in historical perspective, the IBM PC® was first released in August 1981 [3]. So, almost 10 years before the dawn of personal computing, medical toxicologists were already practicing computer-driven telemedicine.

Present

Fast-forward to 2013. Like more than 40 % of Americans my age, I live in a household with only cellular phones [4]. I videoconference with my family using an iPad™, and I get nearly instantaneous updates about friends in Haiti and Rwanda via social media websites. My smartphone can give me turn-by-turn directions to dinner in more languages than I could hope to learn in a lifetime. Yet, every fourth night, I receive a numeric message on my pager, use a telephone to call in to our poison center, and then wait for a teleconference with a provider interested in consultation or transfer. When I ask a poison specialist if a child being followed at home appears well, I can only hope that the child's mother knows what "well-appearing" means. In our predominately rural state, I commonly make decisions about transferring a patient hundreds of miles in a helicopter without having laid eyes on him. While preparing this article, I typed "oxycodone overdose" into Google™. There were no visible references to PCCs in at least the first ten pages of results. How did we

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start out so far ahead of our time and then fall so far behind?

Future

It is difficult to imagine the poison center of the future. We live in an increasingly interconnected world where dinner table arguments are settled instantly by web searches conducted on handheld devices. The only thing that seems certain is the traditional poison center model that answers telephone-based queries from a central location will be forced to radically change in the next few years.

Let us examine, as an example of the new age in telemedicine, the experience of our neurology colleagues in remotely managing acute stroke. Audiovisual (AV) teleconferencing in the evaluation and treatment of stroke (telectroke) developed in the late 1990s, shortly after the approval of recombinant tissue plasminogen activator (rt-PA) [5]. The similarities of telectroke to toxicology are striking. There are a limited number of stroke specialists, concentrated at academic centers and stroke centers. The drug rt-PA has been shown to decrease disability, but many emergency providers are fearful of using it due to rare but serious complications. The utility of rt-PA treatment depends on a careful assessment of the patient, ideally by an experienced clinician familiar with the disease process. Over the 14 years since the term was first coined, telectroke has experienced tremendous growth and widespread acceptance. The American Heart Association has now recommended telectroke, in the absence of an immediately available stroke specialist, based on class IA evidence [6]. A randomized, blinded, prospective trial demonstrated more accurate decision-making regarding the use of rt-PA with telectroke when compared to traditional telephone consultation [7]. While the initial infrastructure of telectroke depended on point-to-point communication (much like the electronic poison information system did in 1972), newer iterations of telectroke will likely integrate AV data transmitted via the web to individual providers' portable devices, allowing simultaneous patient evaluation, review of imaging, and use of the electronic medical record [6].

The barriers to the growth of more advanced teletoxicology are similar to those governing telectroke. In an already financially troubled poison control system, the initial capital investment in secure AV equipment, terminals, and electronic networks may appear overwhelming. Once this investment has been made, there are still many administrative and regulatory controls on the transmission of patient information. Finally, there are the questions of cost/benefit and reimbursement. The Centers for Medicare and Medicaid Services currently allow for reimbursement of telemedicine services via a variety of CPT codes and modifiers, but there are restrictions on payment intended to improve delivery of care to rural and underserved communities [8, 9]. Cost/benefit analysis of telemedicine

programs can be challenging, as the costs and benefits are distributed unequally between the referring “spoke” facilities and the receiving “hub” hospitals and depend on transfer rates between facilities. Captured charges may depend heavily on the payer mix of the population being served and on individual insurers. [10]

In their current state, PCCs clearly improve patient outcomes and save the healthcare system money [11–17]. Hopefully, this alone will impress upon our academic institutions, legislators, and hospital administrators the importance of supporting technological growth in toxicology. PCCs could also make use of an existing infrastructure established for telestroke or remote ICU management. This is likely to appeal to administrators eager to amortize the high upfront costs of such programs. Although information security concerns remain, one study has already demonstrated reliability of NIH Stroke Scale assessment using the relatively inexpensive and widely available iPhone 4™ [18]. Lastly, although reimbursement in telemedicine is not always certain, the paucity of reimbursement for the poison center services we currently provide is. Development of advanced AV consultation services in medical toxicology may afford the ideal opportunity to change our (non-) payment paradigm and alleviate some of the stress of our ongoing funding crisis.

The poison center of the future may take many forms. The American Association of Poison Control Centers Board of Directors has recently approved a motion regarding the development of a web-based Virtual Poison Center. Others are working on smartphone applications to streamline simple interactions, such as drug identification, for non-healthcare users of PCC services. Of critical importance will be identifying new metrics so that the toxicosurveillance, disaster response, and epidemiological functions of PCCs are not lost with the automation of information retrieval. Finally, it may not be long before toxicology consultations are frequently carried out via smartphone or tablet PC, allowing a greater depth of patient assessment than is currently possible. For all of this to happen, we have to continue to advocate for our role in direct patient care and leverage the improved outcomes and cost savings we bring to healthcare systems. Recall that toxicologists were doing telemedicine when barely half of US households had telephones [19]. More than ever, we need to re-stake our claim on this frontier of medicine.

Conflict of Interest None

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